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TODAY AND TOMORROW IN AIR POLLUTION: THE PROBLEM ITSELF AND OUR CONCEPTION OF IT ARE CHANGING

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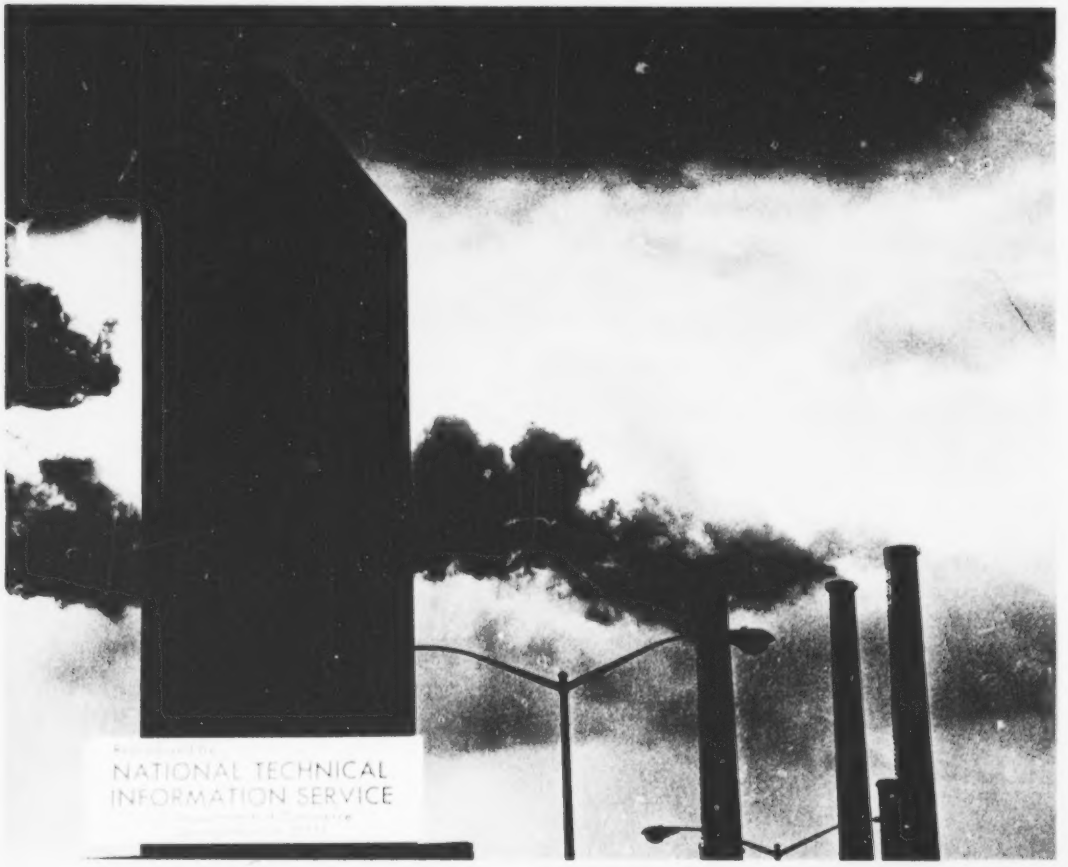
Today and Tomorrow in Air Pollution



U.S. DEPARTMENT OF HEALTH,
EDUCATION, AND WELFARE
Public Health Service

PRINCIPAL AIR POLLUTANTS AND THEIR EFFECTS

At levels frequently found in heavy traffic, *carbon monoxide* produces headache, loss of visual acuity, and decreased muscular coordination.

Sulfur oxides, found wherever coal and oil are the common fuels, corrode metal and stone, and at concentrations frequently found in our larger cities reduce visibility, injure vegetation, and contribute to the incidence of respiratory disease and to premature death.

Beside their contribution to photochemical smog, described below, *nitrogen oxides* are responsible for the whiskey brown haze that not only destroys the view in some of our cities, but endangers the takeoff and landing of planes. At concentrations higher than those usually experienced, these oxides can interfere with respiratory function and, it is suspected, contribute to respiratory disease. They are formed in the combustion of all types of fuels.

Hydrocarbons are a very large class of chemicals some of which, in particle form, have produced cancer in laboratory animals, and others of which, discharged chiefly by the automobile, play a major role in the formation of photochemical smog.

Photochemical smog is a complex mixture of gases and particles manufactured by sunlight out of the raw materials—nitrogen oxides and hydrocarbons—discharged to the atmosphere chiefly by the automobile. Smog, whose effects have been observed in every region of the United States, can severely damage crops and trees, deteriorate rubber and other materials, reduce visibility, cause the eyes to smart and the throat to sting, and, it is thought, reduce resistance to respiratory disease.

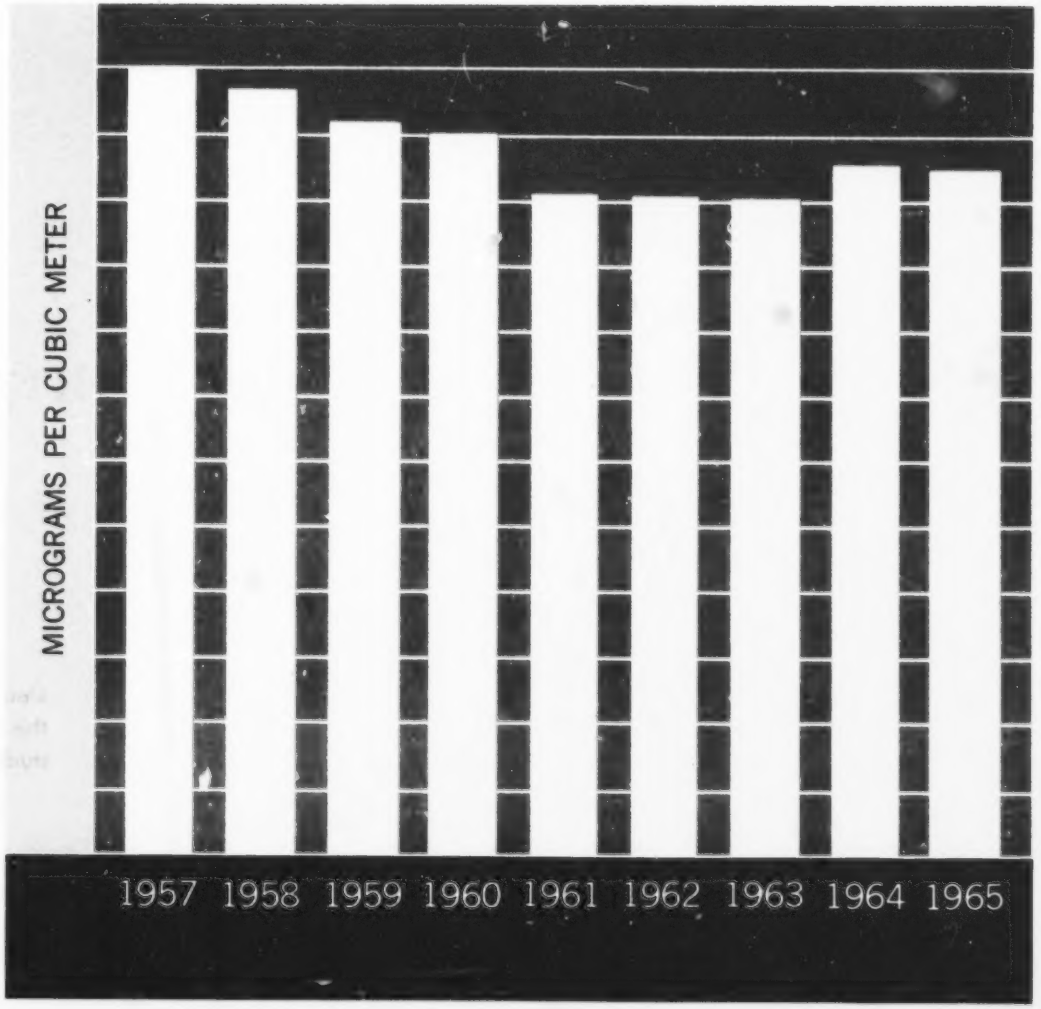
Particulate matter not only soils our clothes, shows up on our window sills, and scatters light to blur the image of what we see, it acts as a catalyst in the formation of other pollutants, it contributes to the corrosion of metals, and in proper particle size can carry into our lungs irritant gases which might otherwise have been harmlessly dissipated in the upper respiratory tract. Some particulates contain poisons whose effects on man are gradual, often the result of the accumulation of years.

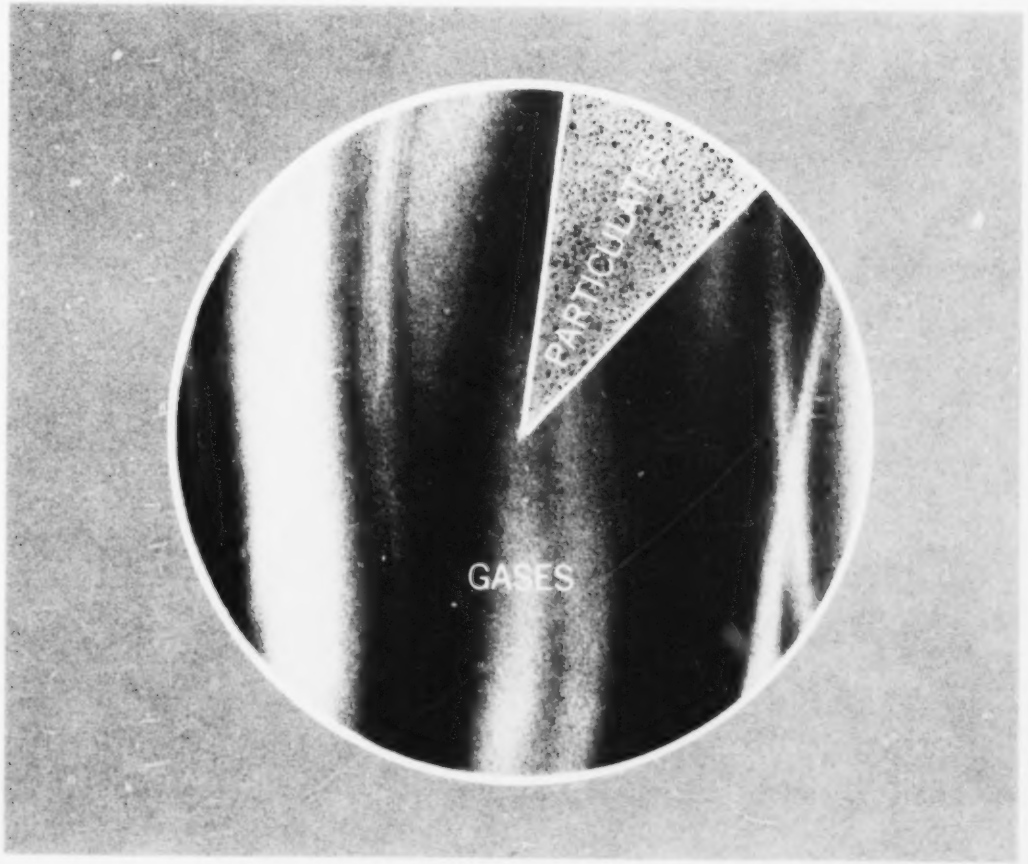
The problem itself and our conception of it are changing.

Details of illustrations in this document may be better studied on microfiche.

Around two decades ago, when smoke pollution reached its zenith in the United States, the problem of air pollution was still regarded as a local nuisance. Public indignation was focused more directly on dirty shirts than on dirty lungs, and in a number of eastern and midwestern industrial cities, smoke was so thick so much of the time, particularly in the winter, that it is difficult to understand how people tolerated it for so long. Finally, the sheer soiling nuisance of the problem provoked public outcries loud enough to eventually be heard, and smoke pollution ordinances were enacted and partially enforced. This control effort, coupled with the fortuitous replacement of steam locomotives by diesels and the increasing use of gas for space heating, visibly improved the skies of many cities. As the graph shows, between 1957 and 1961 the levels of particulate matter in our city atmospheres declined considerably.

It should be underlined that these local control efforts of the 1930's, '40's, and even of the early '50's focused on the limited objective of curtailing a nuisance.



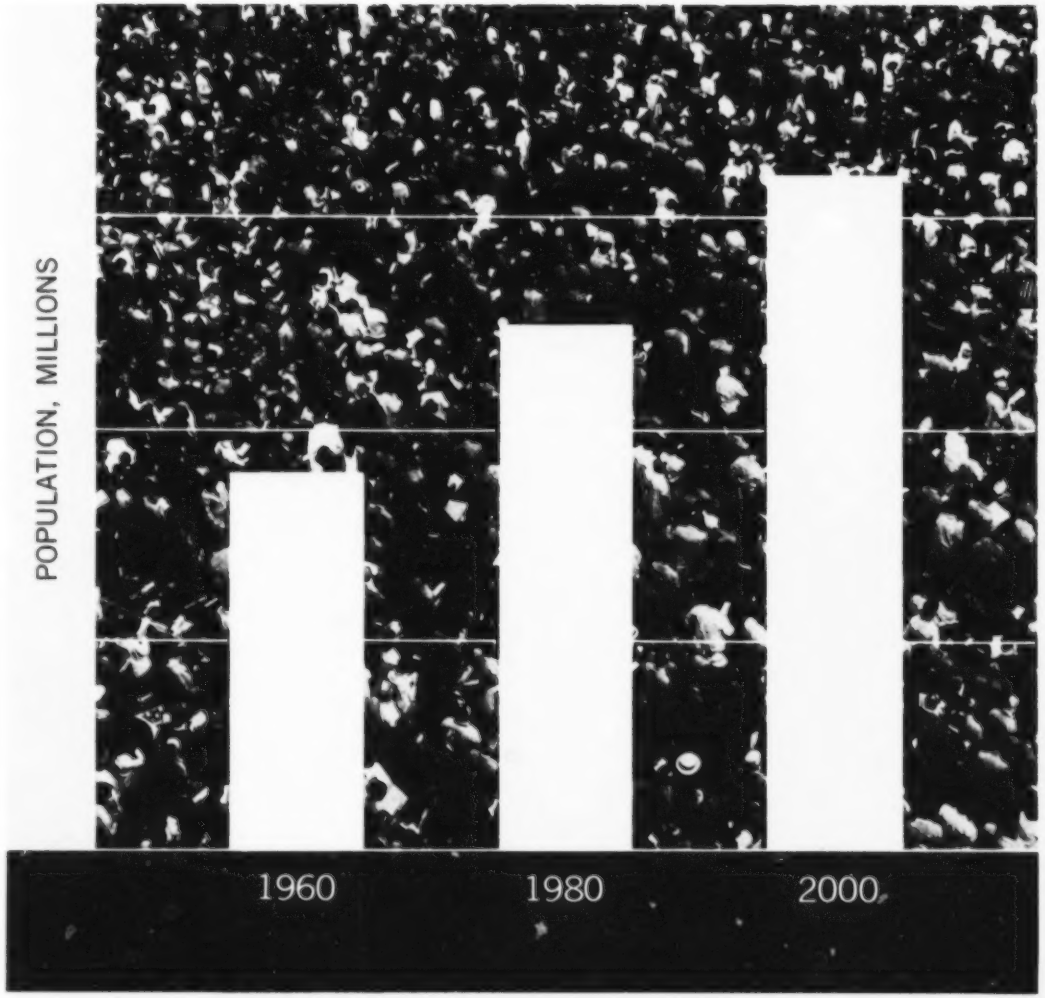


Today, the situation is dramatically different. Today we are not only concerned with the soiling nuisance of smoke, we are now concerned with a host of gaseous and particle pollutants which overload the capacity of the atmosphere to disperse them, with highly unpleasant or even, at times, disastrous results. In less than two decades we have come a very long way in our understanding of the problem of air pollution. We no longer regard the problem as a mere nuisance; we see it as a ubiquitous threat to health and welfare. And as we have begun to understand the true nature of air pollution we have become aware that we are going to have to run very fast in the years ahead if today's serious problem is not to become critical tomorrow. All the major trends of growth in our society contribute to a worsening problem, and unless we markedly increase our control efforts the Nation's growth will produce a truly critical problem.

Air pollution is an unwanted by-product of our successful pursuit of a higher standard of living.

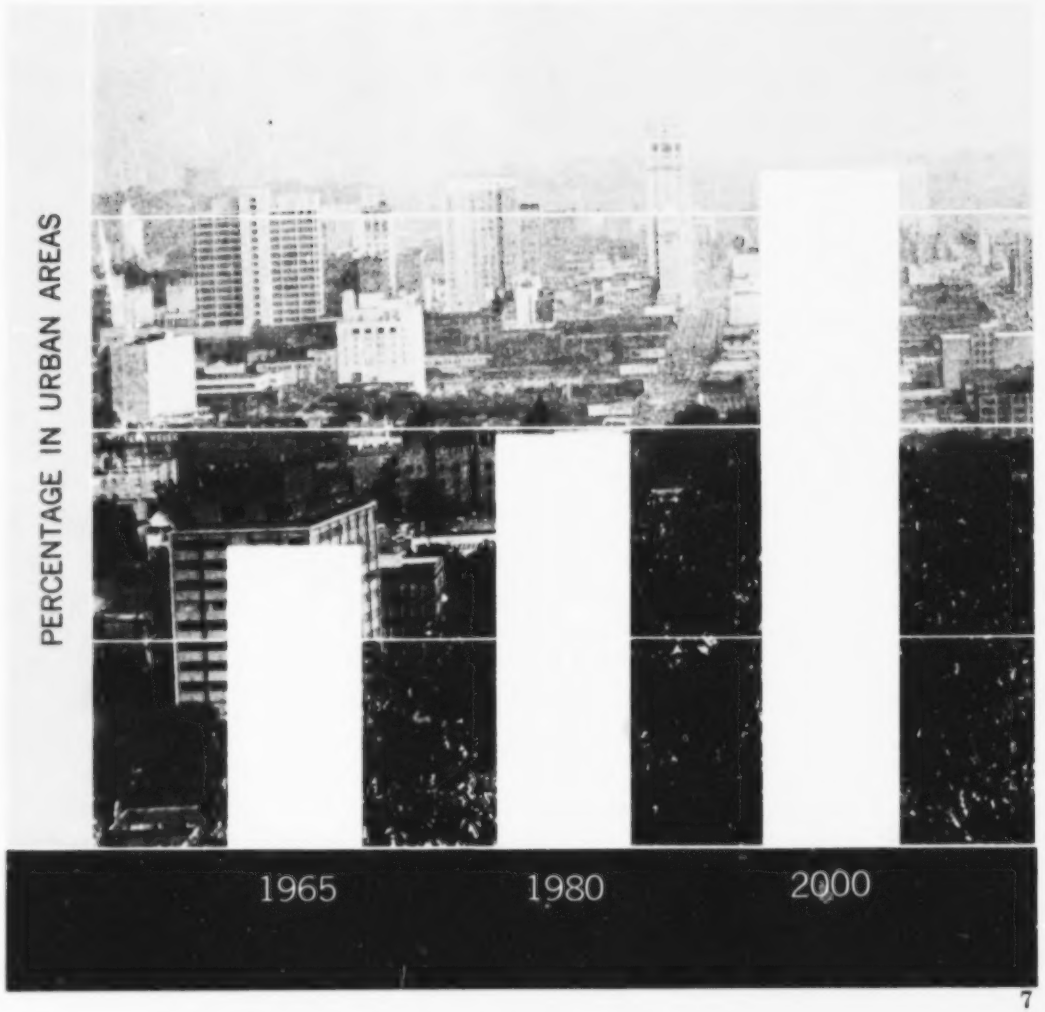
more people . . .

In 1960 the United States had a population of approximately 180 million. By 1980 it is estimated that the population will rise to 250 million, and by the end of the century to 320 million—almost double what it was in 1960. These increasing numbers of people will drive cars, buy manufactured goods, dispose of wastes, heat homes and offices, and use electrical power in dozens of ways just as we do today. In fact, they will demand more goods and services per capita than we do, and their demands will be met.



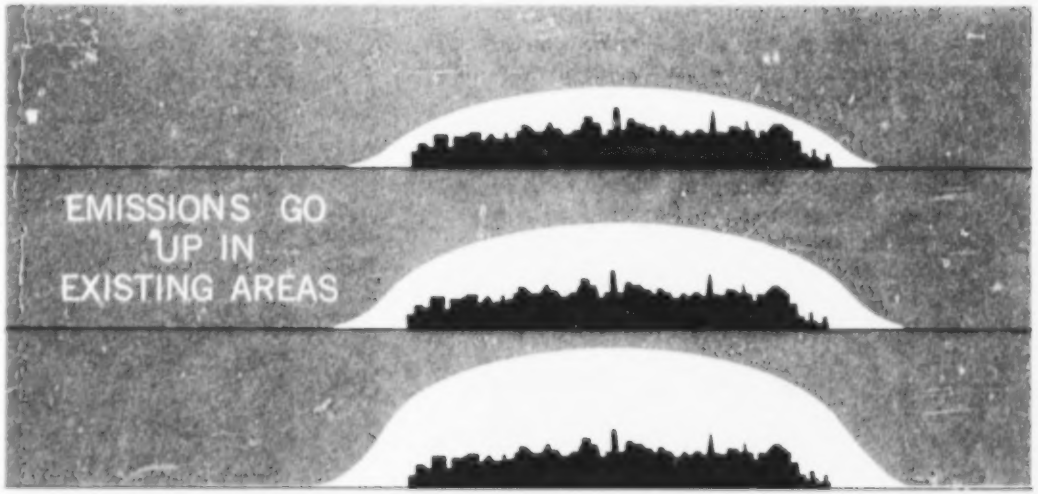
more people in the city . . .

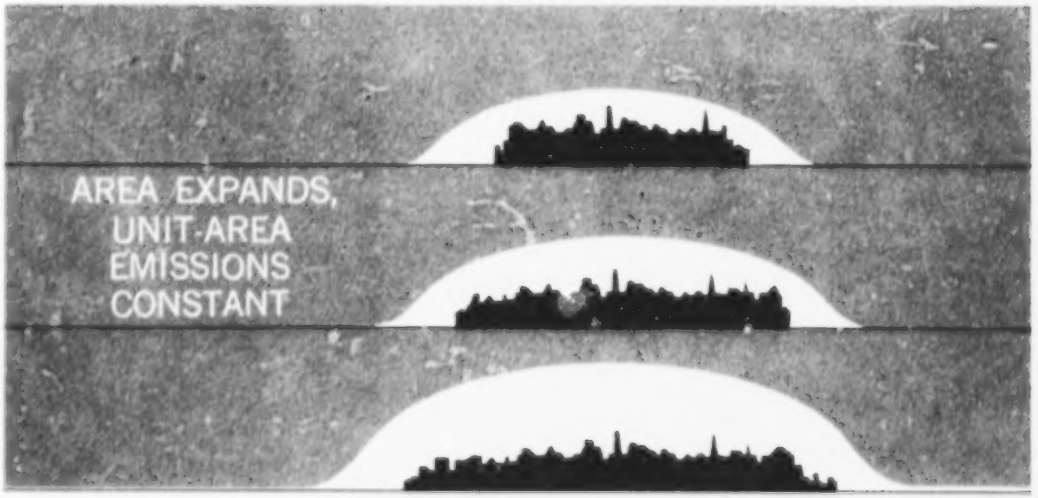
People and the sources of air pollution tend to concentrate in the same places, which means in effect that the problem of air pollution presses hardest on our cities. In 1965, 141 million people lived in our cities. By 1980 this figure will rise to 198 million, and by the end of the century 85 percent of a population of 320 million will be urban, concentrated on less than 10 percent of our total land area.



more pollution in the city . . .

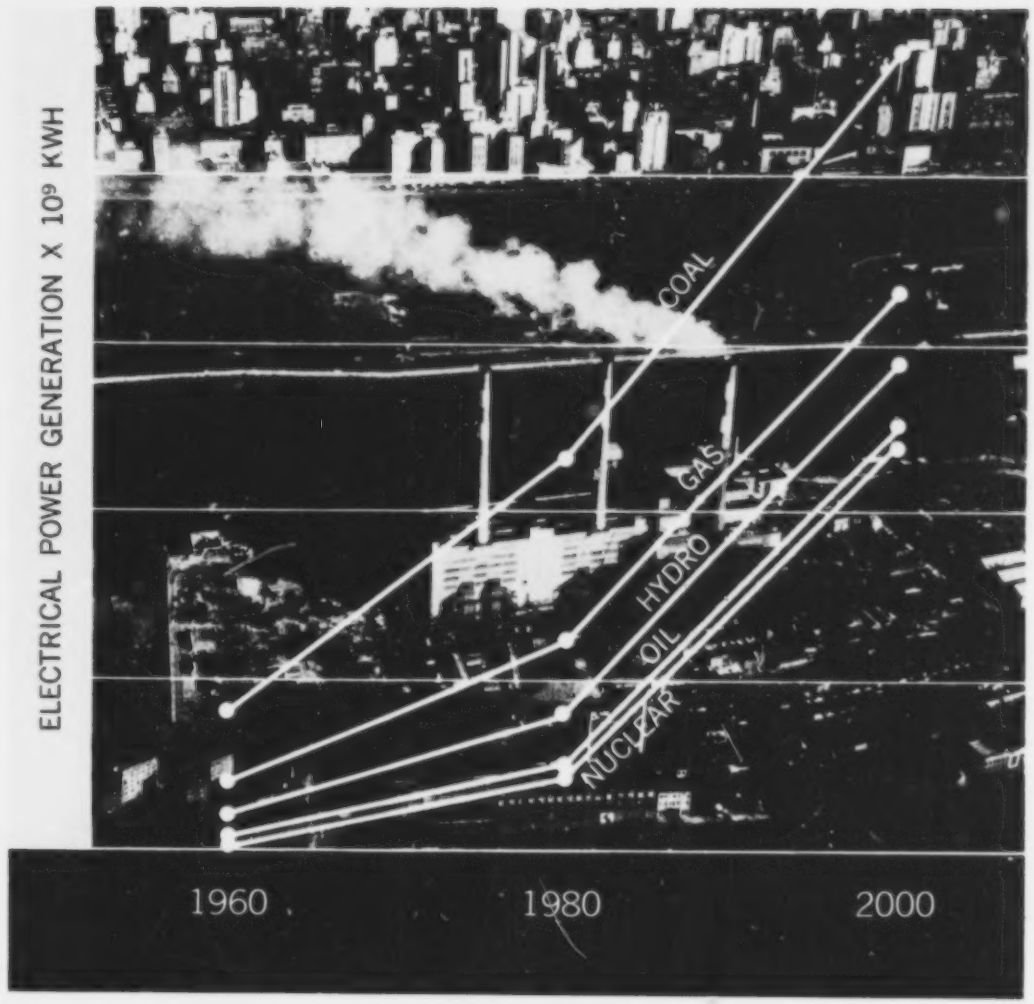
The growth of cities takes two principal forms. They grow in density or they spread out. For the most part, they grow in both ways. But whichever form it takes, growth invariably increases air pollution in the city. It is obvious that if a city grows more dense, pollution levels will go up. Though it may not be as obvious, it is also true that pollution levels go up when a city spreads outward.





more electricity . . .

The amount of electricity consumed in the United States is higher than in any other country in the world, and with every passing year the amount multiplies. By 1980 it is estimated that we will be using almost three times the amount of electricity we used in 1960, and by the end of the century between five and six times as much. In 1960, nuclear and water energy, neither of which contribute significantly to air pollution, supplied a small fraction of our needs, and nuclear energy undoubtedly will be increasingly used in the future. However, by far the greatest source of energy is now and will continue to be, for the remainder of this century, the burning of coal and oil. The combustion of these fuels is already a major contributor to the pollution of our atmosphere.



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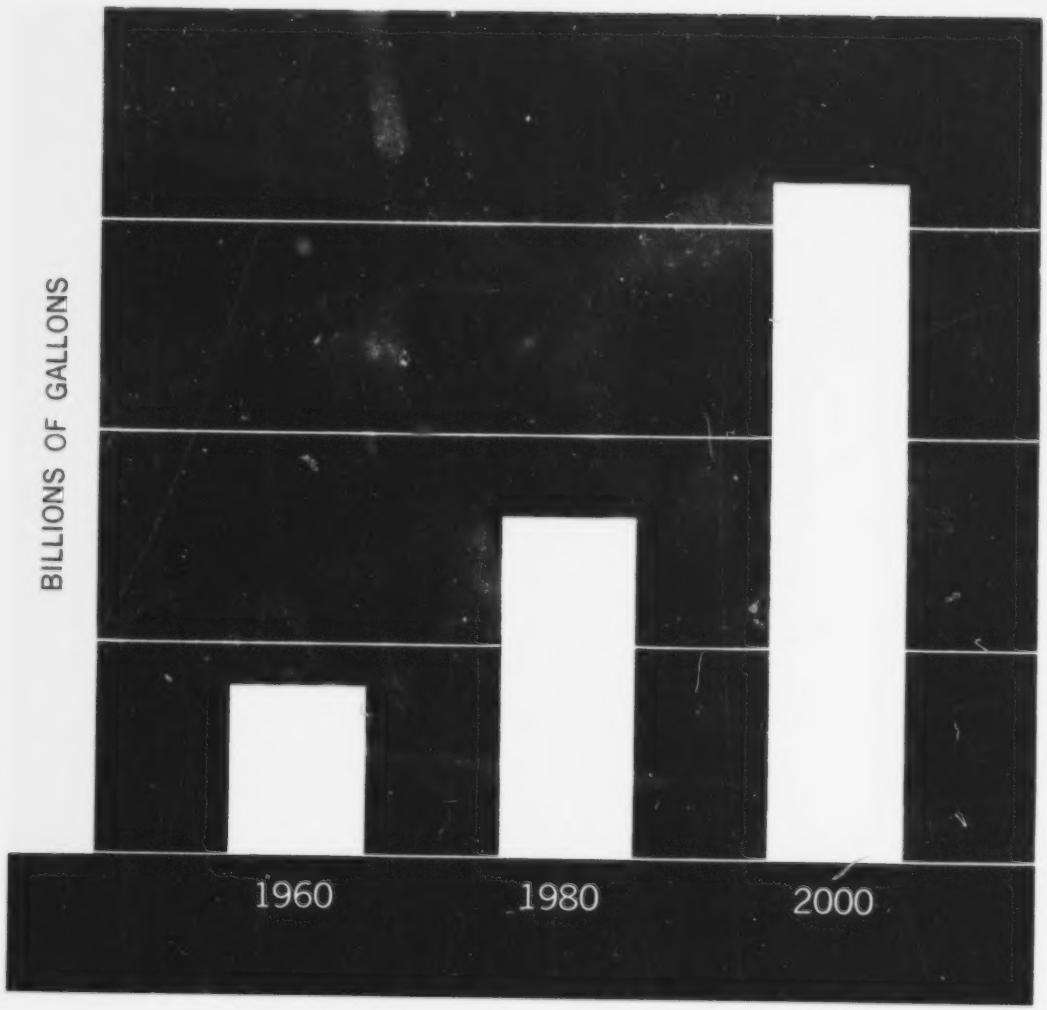
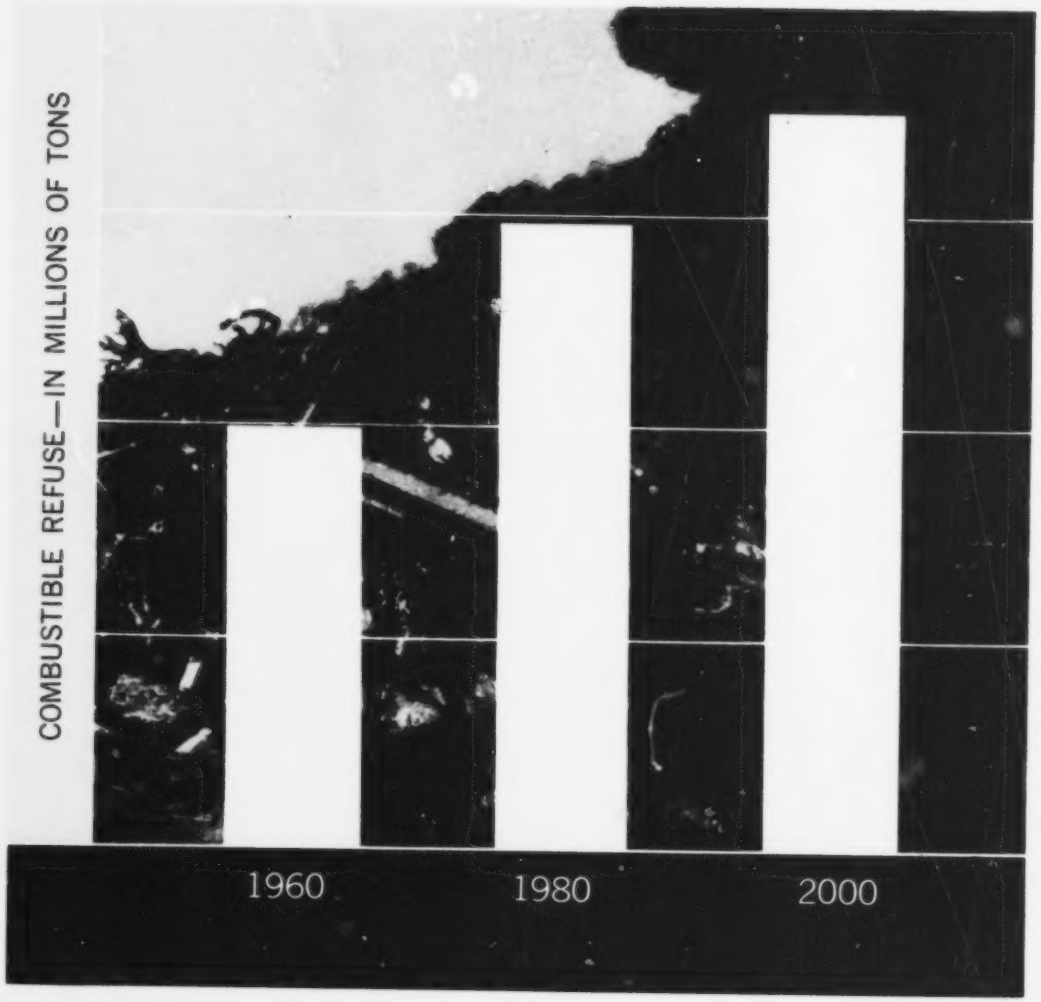
more cars and more gas . . .

There were about 60 million privately owned automobiles in this country in 1960, and together they consumed more than 40 billion gallons of gasoline. If present trends continue, the number of cars and the gas they burn will double by 1980, and quadruple by the end of the century. Our cities will bear the brunt of the burden of pollution this increase entails—93 percent of all auto trips are entirely or partially within cities.



more garbage . . .

On the average each American throws away more every year than he did the year before. In 1930 it was 650 pounds, 500 of which were combustible. By 1960 the per capita figure for combustible refuse had risen to 1,100 pounds. And even if we assume that the per capita rate stays the same, the total annual production of combustible waste will rise to a whopping 175 million tons by the year 2000, enough to bury all of Washington, D.C., in 30 feet of trash.



more industrial production . . .

The growth of industrial production has, on the whole been steady, and it can be expected to continue.

Manufacturing production in 1965 was 43 percent above the annual average for the period 1957 through 1959.

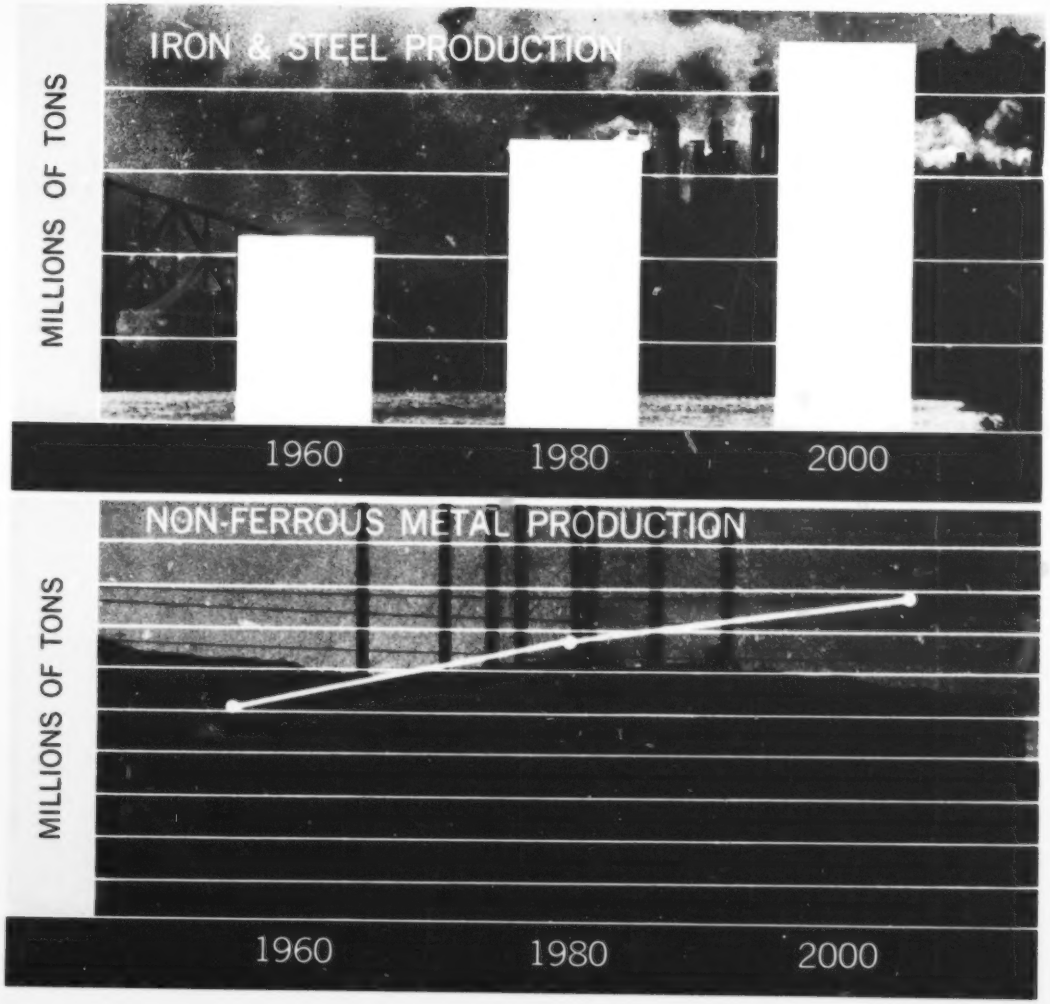
Our annual production of 160 million tons of iron and steel in 1950 had gone up to 220 million tons by 1960. At this rate of increase we will produce 340 million tons of iron and steel in 1980 and 460 million tons in the year 2000.

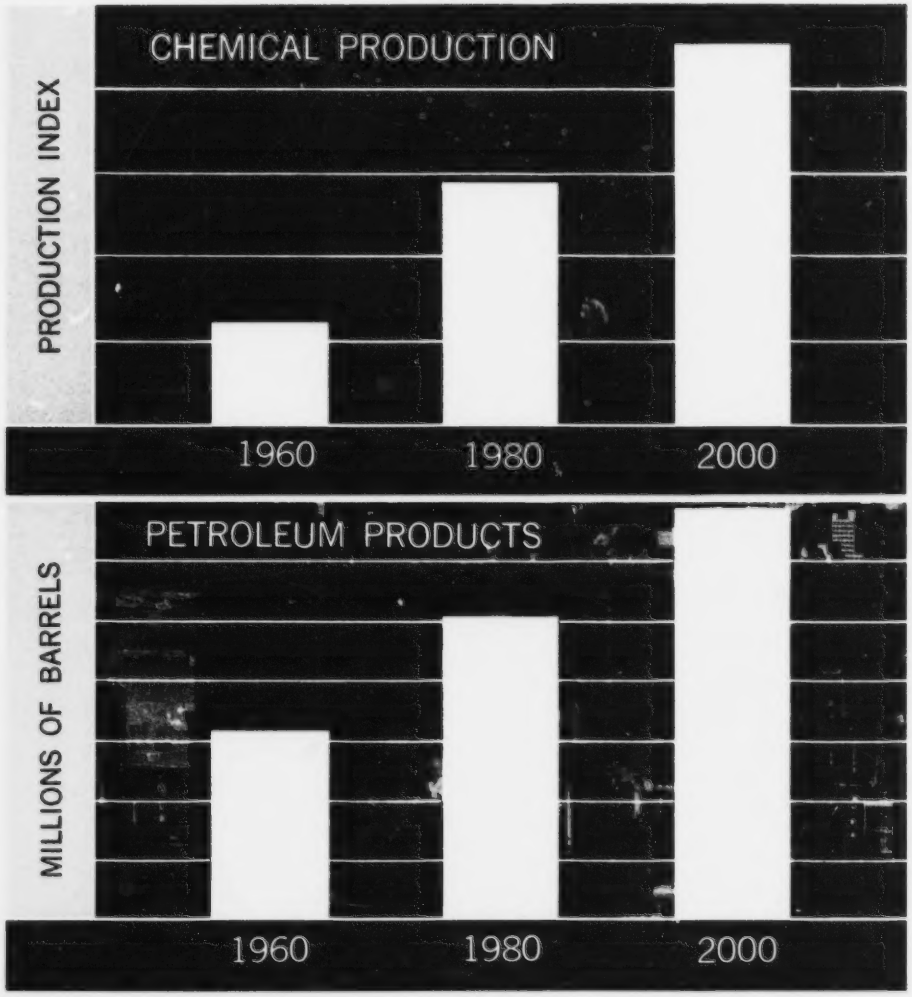
The production of nonferrous alloys is also expected to go up.

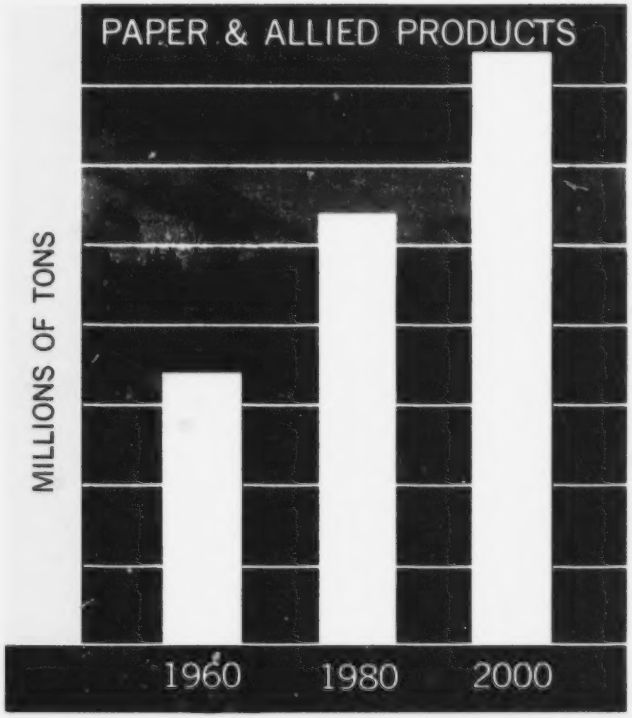
The production of chemicals and allied products was 70 percent higher in 1965 than the average annual production in the 1957 to 1959 period. At this rate of growth, production in the chemical industry will treble by 1980 and be up four and one-half times by the end of the century.

The demand for petroleum products grows steadily. In 1950 we used approximately 2,200 million barrels of petroleum products, and in 1960 we used 3,160 million barrels. At this rate the demand will grow to more than 6,930 million barrels by the year 2000.

Paper and paperboard production has increased steadily—10 million tons in 1930, 14 million in 1940, and 34 million in 1960. If this trend continues, a staggering 74 million tons of paper and paperboard will be produced in the United States in the year 2000.

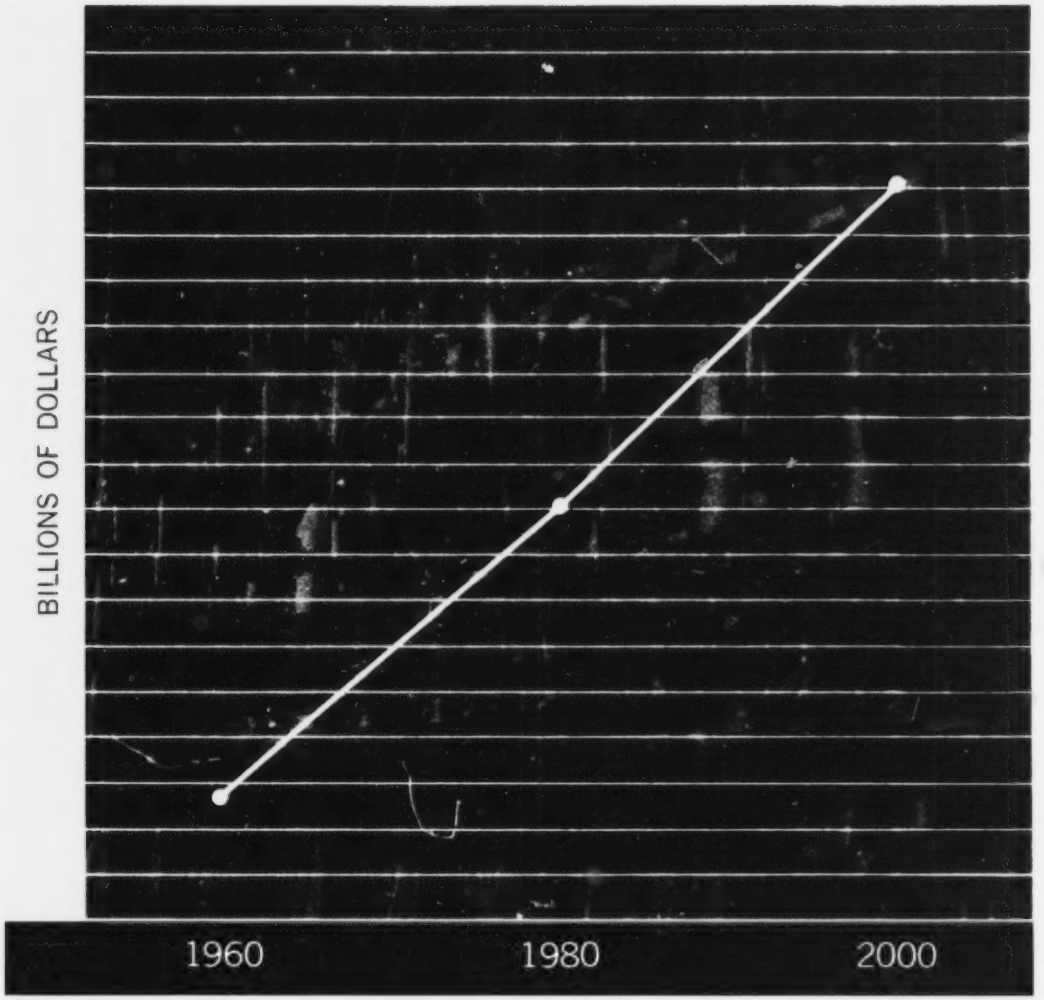






These are some of the major industries that contribute to the contemporary problem of air pollution. Their continued growth, unless accompanied by a massive application of control, can only mean a larger contribution in the future.

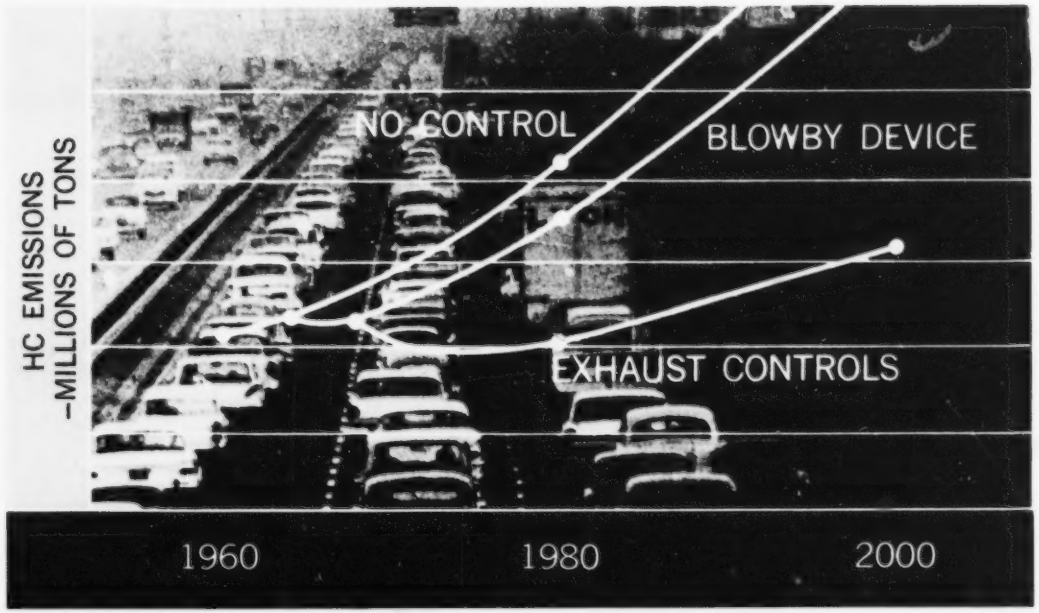
more new products and materials...



The annual outlay for research and development will more than double between 1960 and 1970. By the year 2000 it can be expected to go as high as $80 billion per year. That's right, billion. New products will multiply, new materials will be created, and new ways of using old materials will be developed. Unless the magnitude of our air pollution control efforts is stepped up to meet the challenge, we must be prepared to face the by-product problems of these technological successes —new kinds of pollutants in the atmosphere and new kinds of effects on ourselves and our children.

Tomorrow's levels of air pollution will be higher.

higher levels of hydrocarbons . . .



The Clean Air Act Amendments of 1965 direct the Secretary of Health, Education, and Welfare to prescribe standards for the emission of any substance from new motor vehicles which may be injurious to the public health or welfare. In March of 1966 Secretary Gardner issued standards for emissions from new automobiles and light trucks, the standards to become effective with 1968 model vehicles. These standards require a substantial reduction in the amounts of hydrocarbons and carbon monoxide that can be discharged from the tailpipe, and prohibit any emission from the engine crankcase.

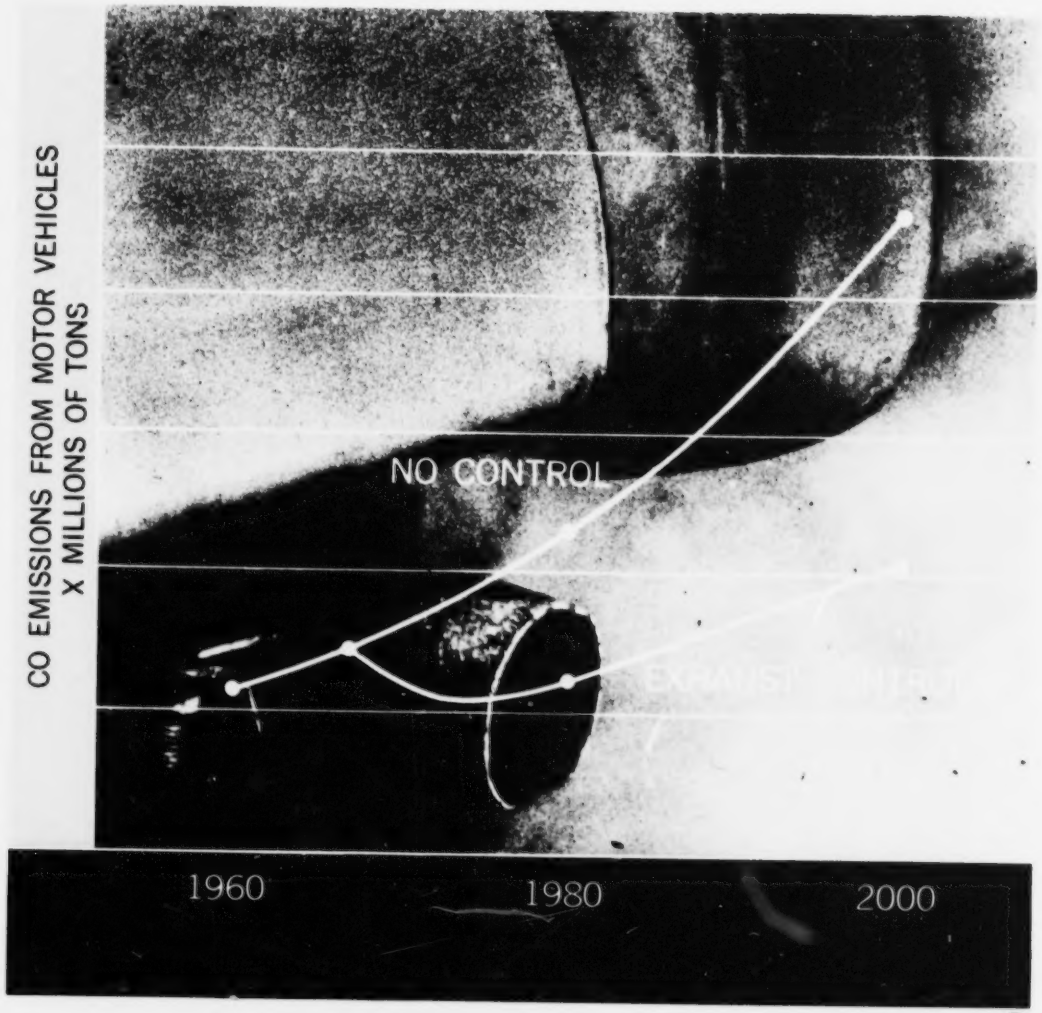
By projecting the effects of these standards against the predicted increase in the number of motor vehicles we can draw a clear illustration of the impact of present trends of growth on the air pollution problem, and of the urgent need for applying control now.

In 1960 gasoline powered motor vehicles discharged more than 11 million tons of hydrocarbons to the atmosphere of the United States, and each year as the number of vehicles and the amount of fuel they consumed went up, so too did hydrocarbon pollution. In 1963 most new American cars began to come off the assembly lines with devices that partly controlled hydrocarbon emissions from the crankcase, and the upward trend in hydrocarbon pollution, was reversed. The reversal was short lived. The steady increase in the fuel used by our growing automobile population soon overtook the progress we made with the crankcase controls, and today hydrocarbon pollution is again on the rise.

Beginning in the fall of 1967, when new cars will come equipped with improved crankcase controls and with tailpipe emission controls, hydrocarbon pollution will gradually but significantly decline to a low of roughly ten million tons per year in 1980. But unless we improve our control of automotive pollution by this time, the increase in automobile population will again overtake the effect of the controls, and hydrocarbon pollution levels will again begin to rise.

Roughly the same story is true for carbon monoxide. In 1960 privately owned gasoline powered vehicles in the United States discharged approximately 60 million tons of carbon monoxide to the atmosphere. As vehicle use has increased, so has carbon monoxide pollution. This upward trend will be reversed with the national application of controls to 1968 vehicles, but unless these controls are improved, the steady rise in vehicle use by 1988, will have wiped out our progress in reducing carbon monoxide pollution.

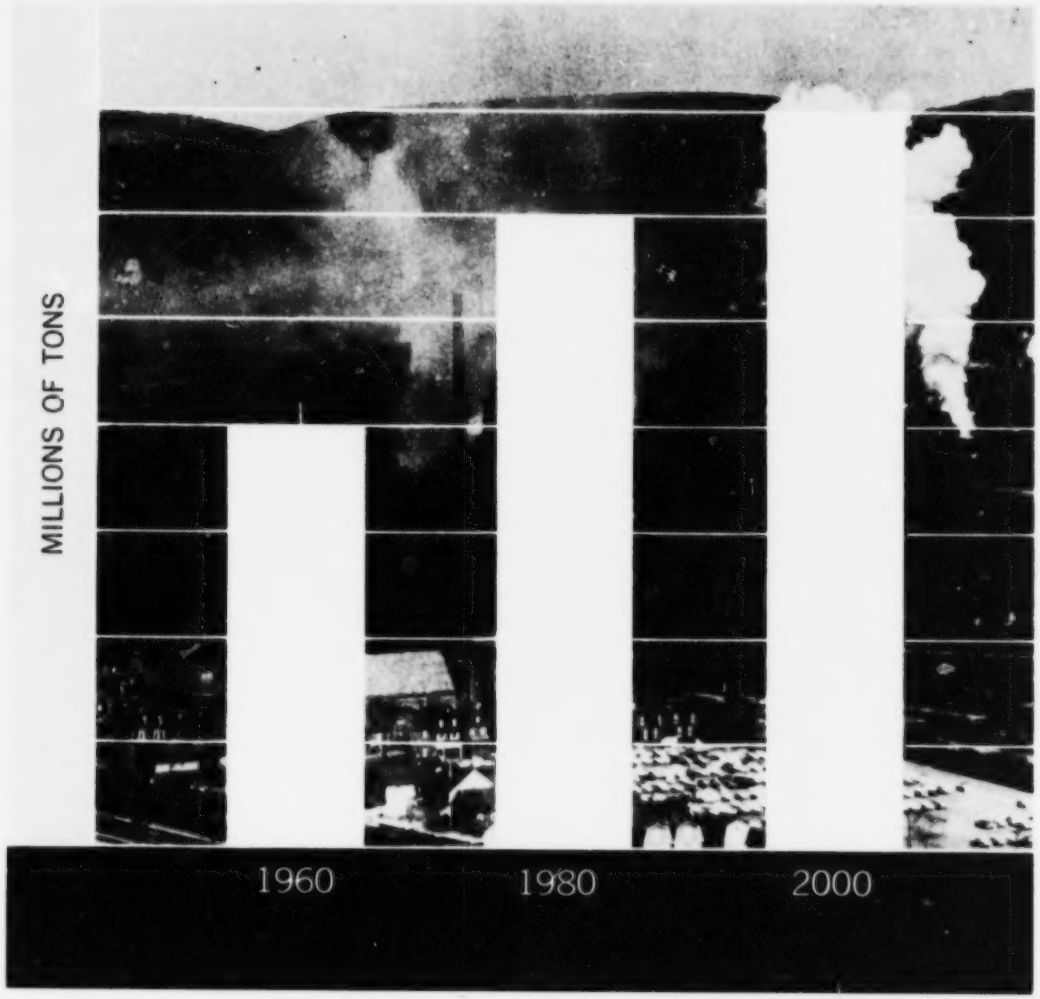
higher levels of carbon monoxide . . .



Coal, petroleum, and natural gas contain elemental sulfur. Natural gas and the lighter petroleum products, such as gasoline, contain negligible amounts; the heavier oils and coal may contain large amounts—up to 10 percent by weight in some coal deposits. When these fuels are burned the sulfur also burns, producing for the most part an irritating gas called sulfur dioxide. It is estimated that more than 20 million tons of sulfur dioxide were discharged to the atmosphere of the United States in 1963. The burning of coal to generate electricity and for other purposes accounts for 60 percent of this amount, the combustion of petroleum products accounts for another 20 percent, and refineries and smelters contribute another 14 percent.

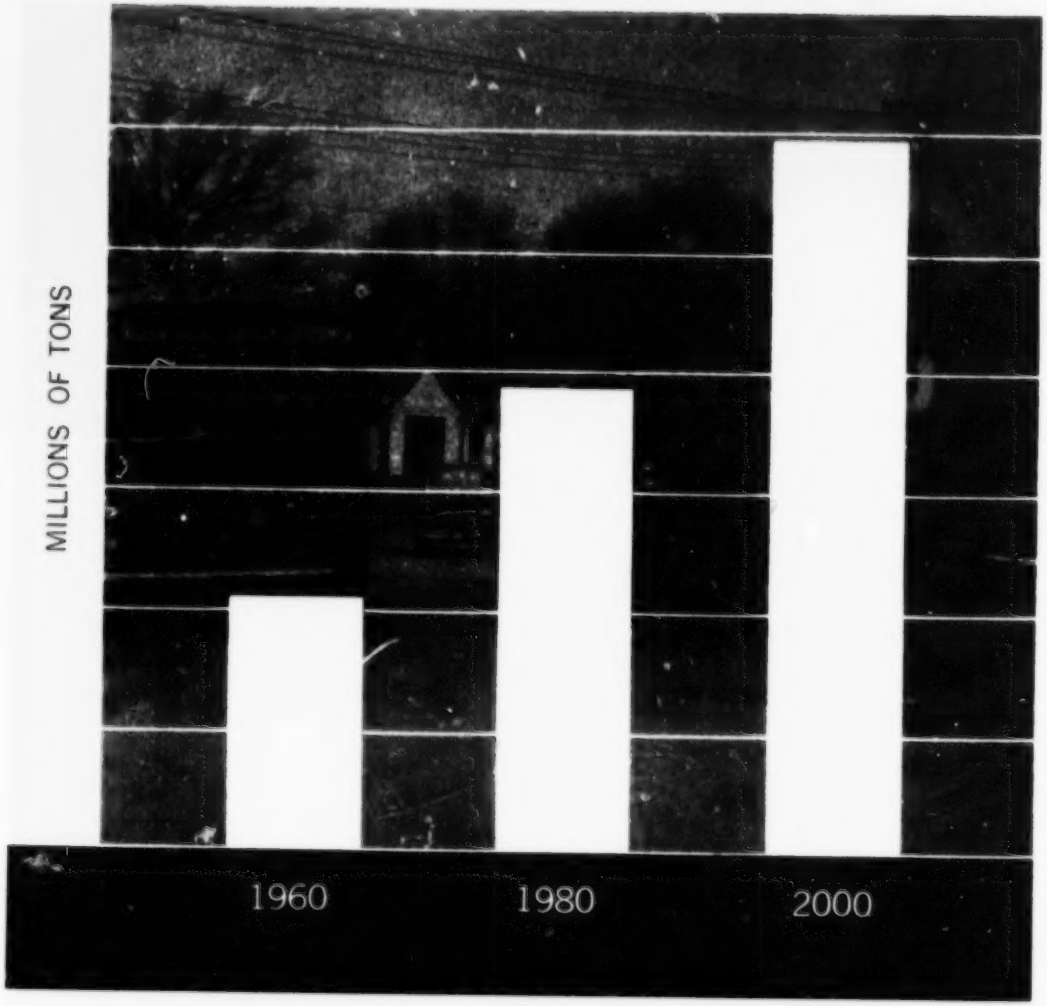
Even if we assume that some degree of control of sulfur dioxide emissions will be achieved in the years ahead, by the end of the century it is estimated that the annual discharge of sulfur dioxide to the atmosphere of the United States may reach 35 million tons.

higher levels of sulphur dioxide . . .



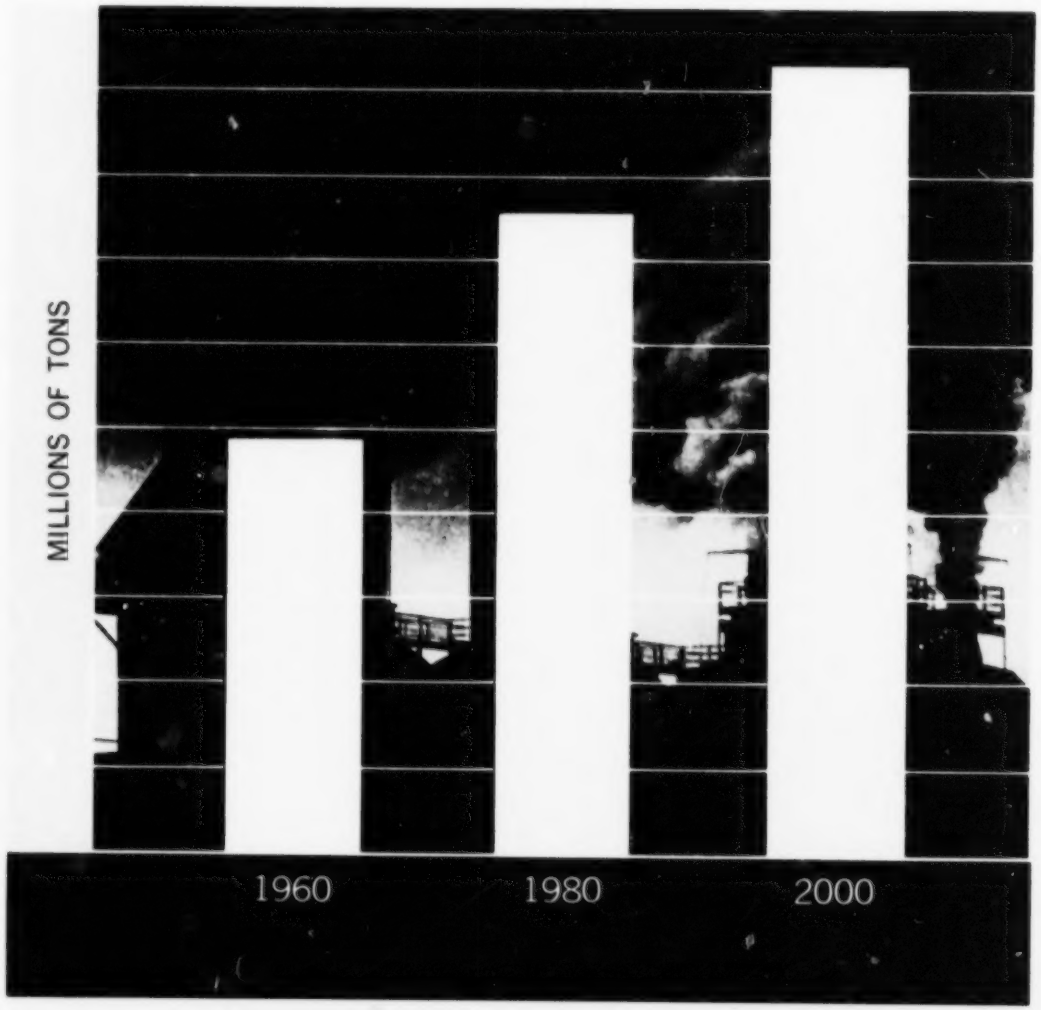
higher levels of nitrogen oxides . . .

About 70 percent of the weight of the earth's atmosphere is nitrogen, which at ordinary combustion temperatures combines with oxygen to form the nitrogen oxides. In addition to their part in the production of photochemical smog, nitrogen oxides are suspected of being a health hazard. Their production during the burning of coal, oil, gasoline, and natural gas will increase from 11 million tons in 1960 to 18.3 million tons in 1980, and to 29.5 million tons in the year 2000. The portion of this pollution contributed by the gasoline-burning automobile can be expected to rise from 45 percent in 1960 to 60 percent in the year 2000.



higher levels of particulates . . .

Over the past three decades, control of the larger and more obvious sources of smoke and fly ash, the increased use of gas for certain types of space heating, and the replacement of locomotives by diesel engines served to sharply reduce levels of particulate pollution in many of our cities —until about five years ago. Since that time, particulate levels have begun to show signs of increasing again. Growth, apparently, is again catching up, and unless we improve our control technology and apply it in more adequate measure, it is estimated that particulate levels will rise to nearly double present levels by the end of the century.



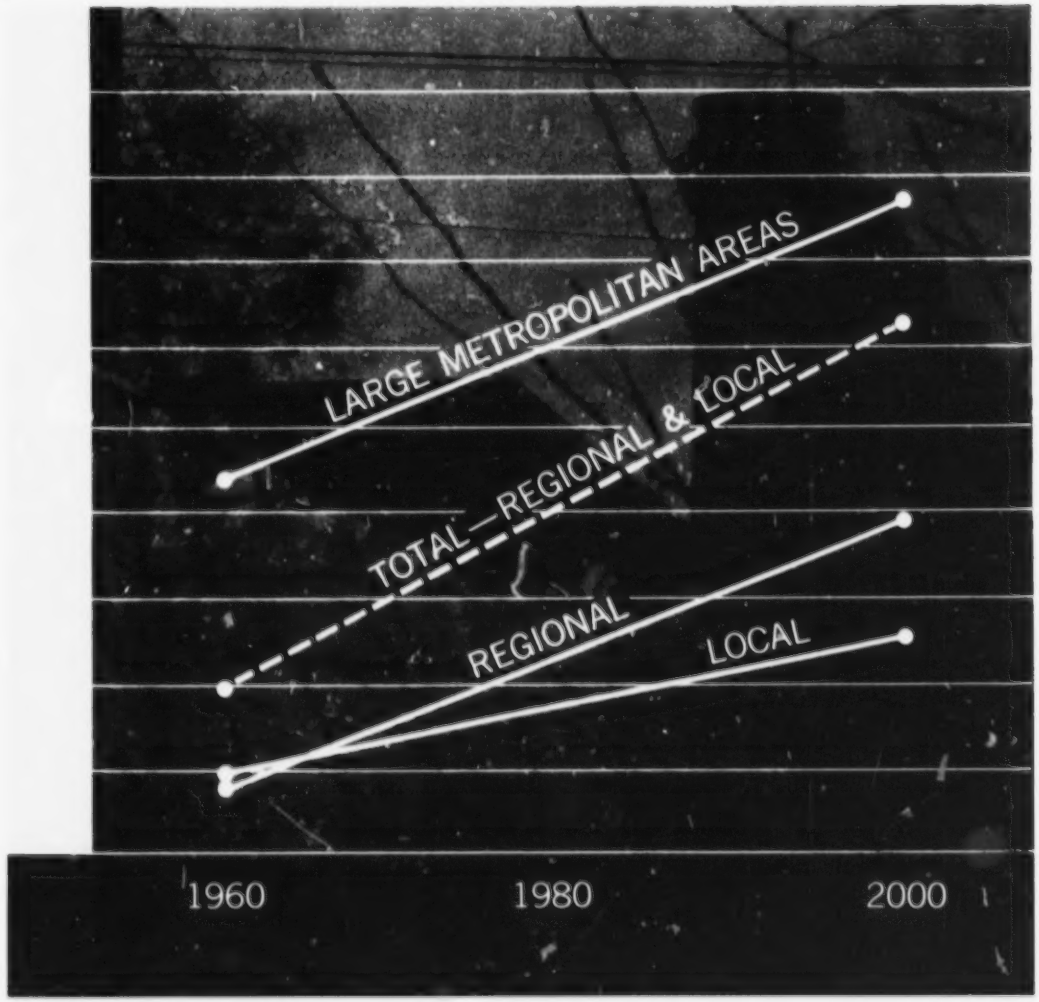
We will have to run very hard in the future just to stay even.

greater efforts at local and regional levels . . .

In 1952 there were only 40 local air pollution programs meeting at least minimum requirements—programs with regulatory authority budgeting $5000 per year and 3 cents per capita. By 1965 the number of such programs had gone up to 61. At this rate there will be approximately 121 local programs meeting at least minimum requirements by the end of the century. In 1952 there were 4 regional air pollution programs meeting these requirements and by 1965 there were 56. At this rate there will be 192 regional agencies in operation at the end of the century.

It is impossible to say just how many local and just how many regional programs we should have in the years to come. As urbanization spreads, many places which now have individual problems and local programs to control them will in the future share problems with other places and would be better served by regional programs. Even new urban places will, for the most part, come into being as part of metropolitan complexes.

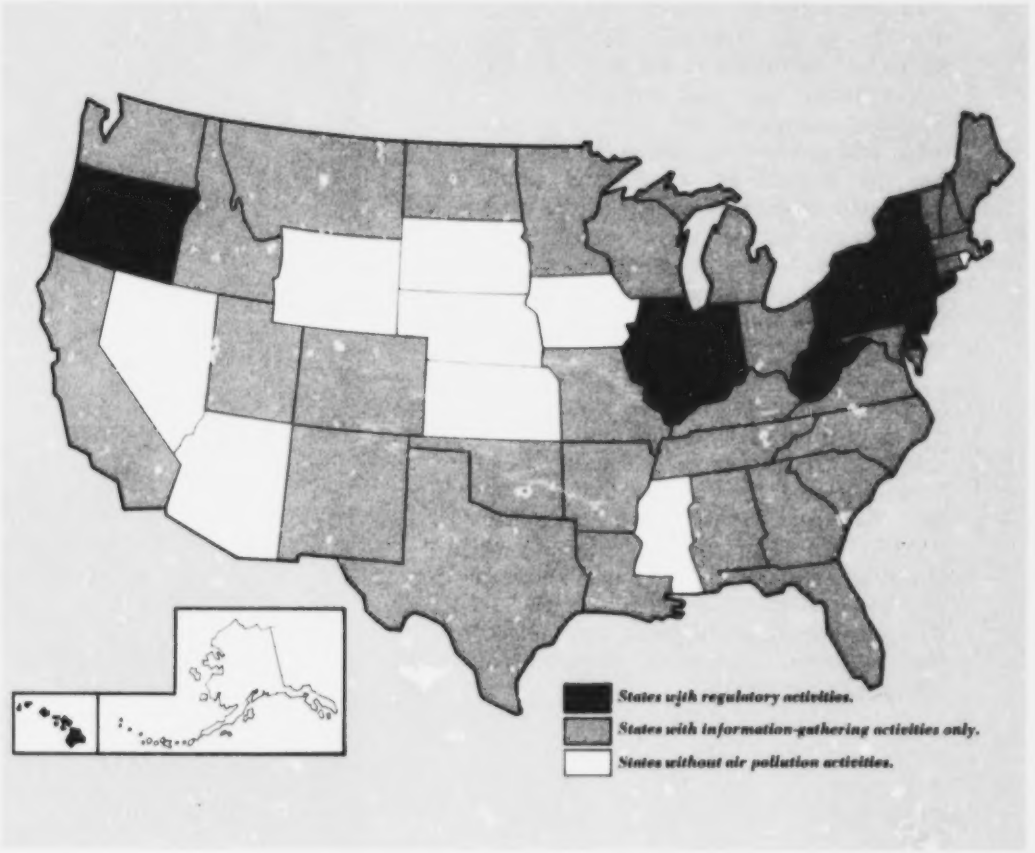
What can be said about the needs for future local and regional programs is that we will need more of them than current trends indicate we will have. As the graph shows, the projected total number of local and regional programs will not even by the end of this century catch up with the predicted increase in the number of large metropolitan areas.



greater efforts by State governments . . .

In addition to providing research and technical assistance to local and regional programs of air pollution control, every State should provide regulatory protection for those communities which for one reason or another, cannot feasibly protect themselves. There are, for example, many communities, even large ones, which may be fumigated by sources lying outside their jurisdiction. And in virtually every region of the country there are small industrial towns, which have serious air pollution problems, and which cannot realistically be expected to control the sources that cause their problems.

Just before the Clean Air Act became law in 1963, 17 States had air pollution programs with annual budgets of $5000 or more. Not more than six, even with generous interpretation, could be said to engage in regulatory activities. By the end of 1966 forty of the States had air pollution programs, but again, only a fraction —nine—included regulatory activity.


States with regulatory activities.
States with information-gathering activities only.
States without air pollution activities.

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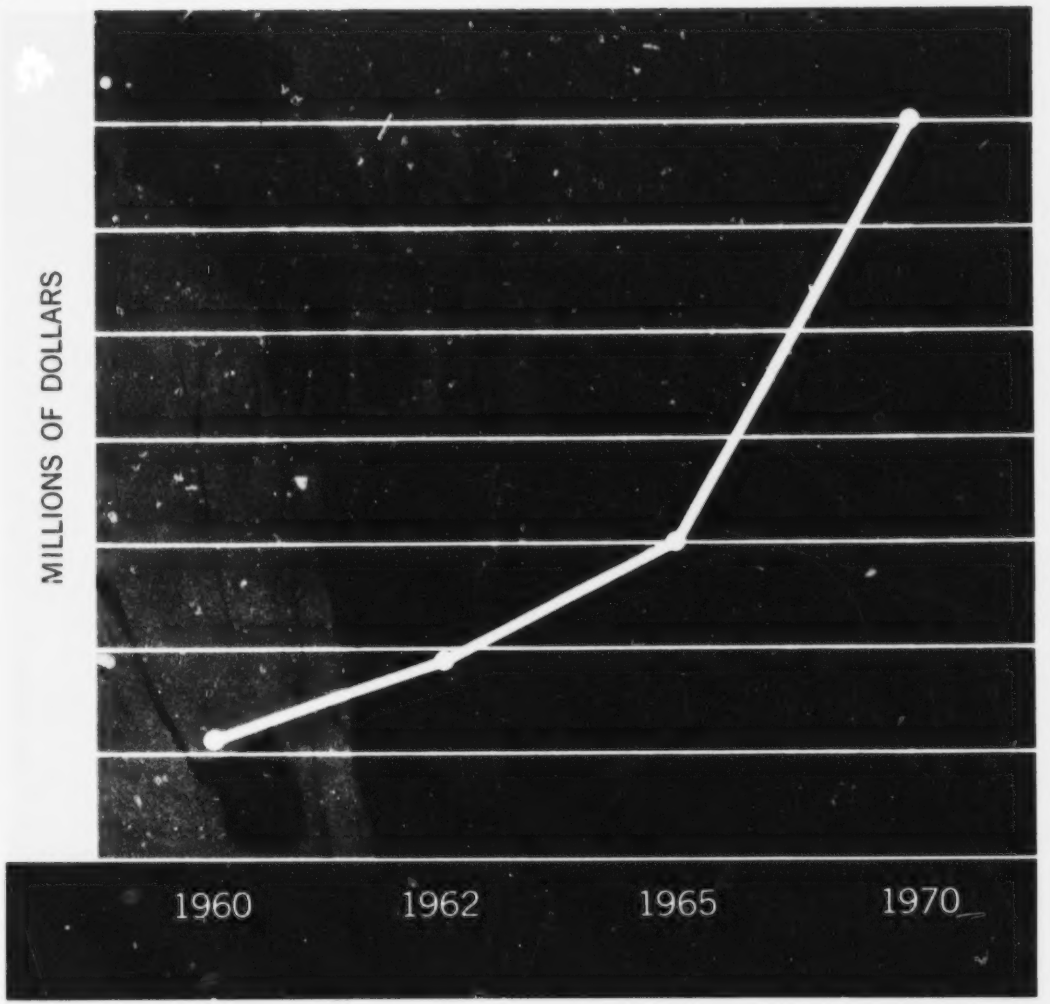
more dollars for research and development . . .

In 1960 about $11 million was spent for research in air pollution. By 1966 this figure had increased to $30 million. This sum reflected increased budgets by universities, industrial and other organizations, and governments at all levels. Under the stimuli of a growing public awareness of the seriousness of the problem and government incentives, it is expected that industry's commitment will be rapidly stepped up and that by 1970 the funds, private and governmental, annually spent on research will reach $70 million.

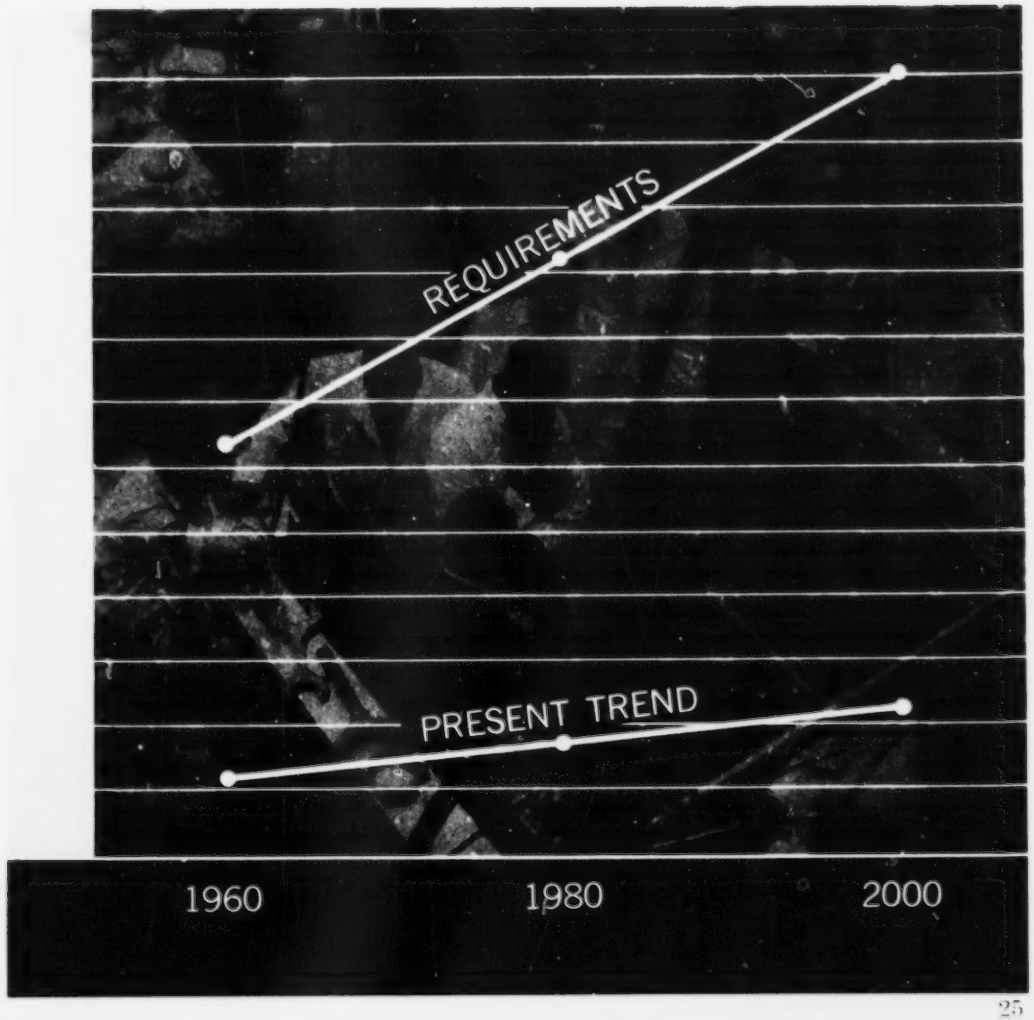
Estimates of the amount of money that should be spent on research vary widely, but all of them indicate that the projected amounts are far from adequate. Some have suggested, for instance, that over the next five years industry and government together should be spending annually between $25 and $50 million on methods of extracting sulfur from coal and oil and from their combustion gases, and between $50 and $100 million on developing a pollution-free automobile.



many more trained people . . .

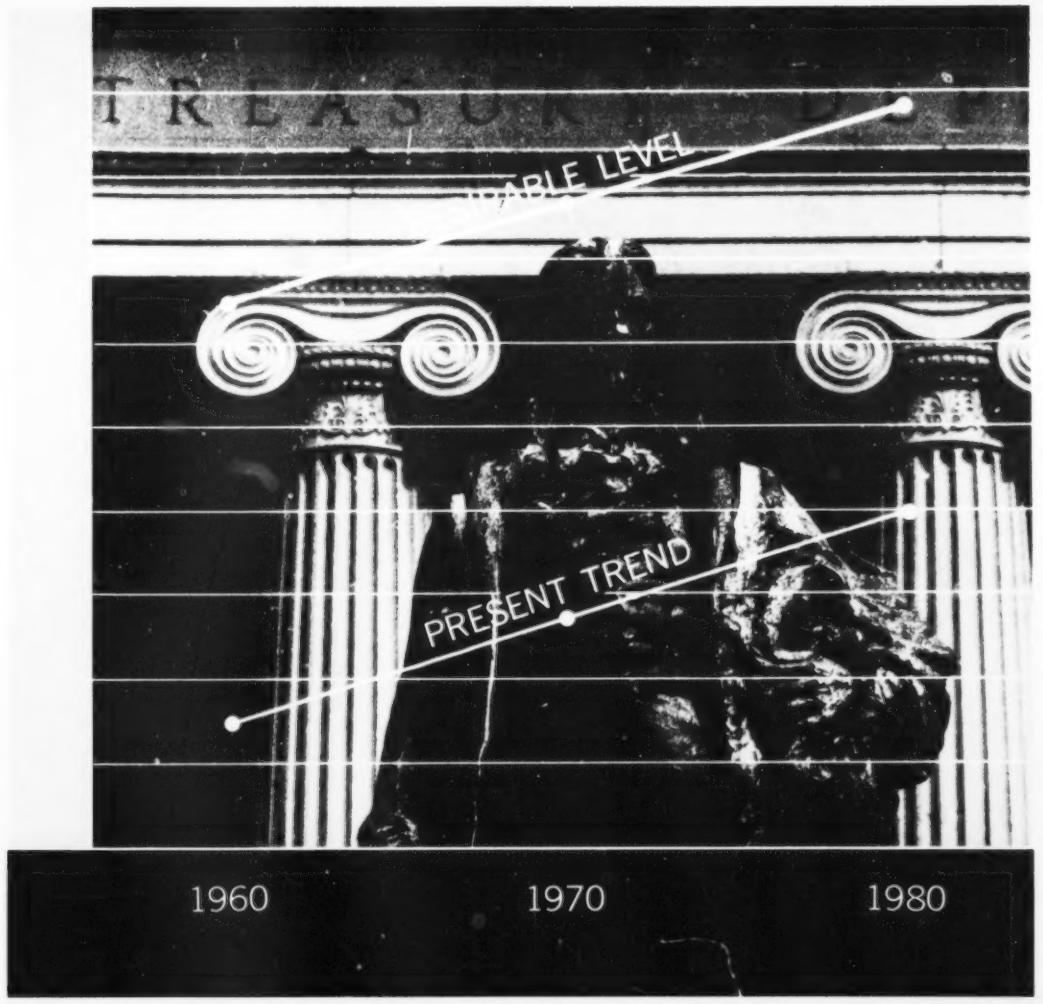
In 1965 there were approximately 1,200 trained persons working in the field of air pollution. To deal with the problem adequately we should have had approximately 7,000. Assuming that all our larger communities will have adequate local or regional control programs by 1980, and that the States will be providing research and technical assistance to these as well as providing regulatory protection to smaller communities, we will by 1980 have roughly 9,000 professional positions in the field. At our present rate of training only a fraction of these positions will be filled.

If we are to come to grips with the problem of air pollution in the coming years, we are going to have to increase our training budgets in massive doses—about $24 million will have to be spent in the next ten years if we are to bridge the gap between the personnel now available, and the required number.



bigger budgets for control programs . . .

Just as air pollution control programs cannot be run without people, they cannot be run without money. At the present time the total annual investment of approximately $20 million for State, local, and regional air pollution programs is hardly adequate in light of estimates that we should be spending $72 million. By 1980 the total State, local, and regional budget for air pollution control should be over $93 million. At our present rate we will budget less than $40 million at that time.



We can do it.

We have today a great opportunity to arrest the fouling of what is perhaps our most precious resource, the air we breathe. We have the technological means of controlling most of the sources of air pollution, we have very real economic and social incentives to do so, and we have the governmental framework through which we can get at the problem. We know that we are particularly vulnerable to any deterioration in the quality of the air, that we must breathe the air as it comes to us, polluted or not. And we know that the future threat of air pollution has never been more serious. The basic question is how can we expand present activities to adequately cope with the problem. There are no gimmicks or magic formulas for controlling air pollution. There are no mysteries we need to plumb before we set out to restore and maintain the quality of our atmosphere. The real question is simply whether we are all, individual citizens, industry, and government alike, willing to exert sufficient energies to halt the contamination of the air we breathe. If we are, the rest is merely hard work.

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AIR POLLUTION IS A COMPLEX PROBLEM

Both the nature and the seriousness of the problem of air pollution can vary from place to place, from season to season, even from hour to hour. Photochemical smog, for example, does not occur at night. In northern parts of the country sulfurous pollution usually is more serious in the cold weather months because we burn more fuel for heating. In southern sections of the country sulfurous pollution may go up in the warm weather months because of the increased air conditioning load on our power plants. The damaging effects of gaseous pollutants commonly are multiplied when particulates are also present in the air.

Some segments of the population are particularly vulnerable to the health effects of air pollution.

The major variables affecting the nature and seriousness of the air pollution problem at any one time and place are . . .

- Types of pollutants
- Quantity of pollutants
- Wind speed and direction
- Topography
- Sunlight
- Precipitation
- Decrease or increase in air temperature with height
- Susceptibility of the individual to particular pollutants or combinations of pollutants